

Attachment 5. Work Plan

This Work Plan identifies and describes the activities necessary to conduct a supplemental study of groundwater resources in the City of Folsom (City) area. This supplemental study is considered Phase 2 of the 2006 City of Folsom Groundwater Resources Study (Phase 1) and is a continued field investigation that includes surface geophysics, exploratory drilling, well installation, aquifer testing and one year of water level monitoring. The goals of Phase 2 are to further evaluate the City's groundwater resources in order to determine the economic feasibility of a sustainable groundwater supply (primarily for non-potable uses), as well as enhancing the conceptual hydrogeologic model of the study area developed in Phase 1. The City's non-potable/recycled water "purple pipe" consumption was approximately 361 acre-feet of treated surface water in 2011.

The project will be focused in the northeastern portion of the City within the Willow and Humbug Creek drainage in the alluvial gravels deposited by the ancestral American River. These alluvial deposits within this drainage consist of sand and gravels and have been historically dredged in many locations. The planned investigation locations and general geology are illustrated on Figure A5-1.

The Phase 2 scope of work includes the following general work tasks:

- Conduct project management, meetings, oversight, reporting, and public outreach
- Complete California Environmental Quality Act (CEQA) documentation and notifications prepare encroachment and drilling permits
- Conduct electrical resistivity and select location for the test well
- Collect water level monitoring of wells and nearby surface water
- Install and develop test well, collect and analyze groundwater quality samples
- Conduct 72-hour aquifer test
- Perform two monitoring well sampling events of Phase 1 and 2 wells.

The work is estimated to take between 15 and 17 months and will be completed within 24 months of the City's date of authorization of agreement with the DWR. An assumed start date is April 2013 and anticipated completion in August 2014. Depending on weather conditions. The project schedule is included in Attachment 7.

SCOPE OF WORK

The following tasks describe in detail the methodologies and anticipated requirements to complete each component of the project. Each task presents a costs and deliverables. Detailed budget and schedule information are included in Attachments 6 and 7 of this application.

Task 1. Project Management, Oversight and Reporting

This task will include management oversight and continually updated strategic direction, as necessary, that will help ensure efficient progress on all facets of the project. The Project Team will consist of project consultants and representatives from the City. A Technical Advisory Committee (TAC) will also be established and include a wider range of participants, including representatives from DWR, Sacramento Groundwater Authority (SGA) and Sacramento Central Groundwater Authority (SCGA), among others.

While the Project Team will have the responsibility of completing the project, and therefore, administer the project on a day-to-day basis, the TAC will provide strategic insight on key issues and, in the case of DWR, provide ongoing oversight regarding compliance with the Prop 84 grant guidelines. Ongoing management oversight, facilitated through regularly held meetings and the

establishment and adherence to strict documentation protocols are all necessary project management components.

All work will be conducted under the supervision of a California Professional Geologist and Certified Hydrogeologist and planning documents and work products reviewed by at least one additional independent California Professional Geologist and Certified Hydrogeologist.

Task 1.1 Project Management and Meetings

A kick-off meeting will be held by the Project Team to reconfirm project goals, objectives, scope, corroborate project schedule, and assign initial project activities. This meeting will clearly identify the overall intent of the Phase 2 study effort and particularly, the manner with which any future independent processes (e.g. CEQA compliance, acquisition of necessary permits, project construction, etc.) will be integrated into the ultimate implementation of this project. The kick-off meeting will also include attendees from the TAC.

The Project Team members will attend bi-monthly meetings during much of the project to review the project's progress, discuss key developmental and strategic issues, identify the need for and methods of acquiring additional data/information, and resolve problems. Nine such meetings are anticipated over the duration of the project. Project maintenance activities include work completed-to-date tracking of billing expenditures, schedule maintenance, problems encountered and options for their resolution, and upcoming work. During the monitoring phase of the project such meetings will be reduced to quarterly.

Deliverables:

- Meeting agendas and notes, invoices

Cost Assumptions

- Project invoicing, budget management, subcontractor oversight, and schedule management will require 4 hours per month. The Kick-off and status meetings will be held at City offices.
- \$300 mileage costs

Task 1.2 Quarterly Status Reports and Groundwater Related Data Reporting

Quarterly status reports (QSR) will be prepared and submitted electronically to DWR as part of the Phase 2 study process. Designated meetings may be held in addition to the monthly project status meetings to review and discuss the contents and implications of these reports. Available monitoring data will be included in the QSRs.

Pursuant to California Water Code Section 10795.15 all groundwater related data collected during the Phase 2 study effort will be submitted to DWR.

Deliverables:

- Five QSRs; electronic submittals.

Cost Assumptions

- Each QSR will require an average of 24 hours of technical staff time to prepare and senior staff review.

Task 1.3 Draft and Final Study Report

A Draft Study Report will be prepared by the Project Team and submitted to DWR and the TAC for review and comment following completion of the field program. The draft study report will include:

- Geophysical subcontractor final report and interpretations,
- Geologic log and DWR Well Completion report – including well construction diagrams, survey report,

- Well development notes and analytical results summary including stiff diagrams and geochemical characterization,
- Aquifer testing analysis and interpretations,
- Groundwater monitoring data including groundwater level data and duration of monitoring.
- Interpretations as to the suitability for the alluvial aquifer to support dry season irrigation demands and relation to the active groundwater management plan.

The report will include conclusions regarding the groundwater resources potential of the study area and recommendations for implementation as appropriate. A meeting will be scheduled to discuss the report and seek consensus on its findings. Electronic distribution of the draft report will also be extended to participants on the TAC.

Upon receipt of all comments from DWR and TAC representatives, the Project Team will prepare and submit to DWR a Final Study Report. Based upon these final conclusions the City will be able to determine the economics of using the groundwater resource for supplying or augmenting the potable water supply currently used for non-potable purposes.

Deliverables:

- Draft study report; electronic deliverable.
- Final study report submitted electronically and hardcopy.

Cost Assumptions

- The draft report will require 200 hours of senior and junior technical effort; GIS technician; graphics and administration staff. Eight hours of a principal technical reviewer for QA/QC is included. Electronic distribution of draft report. One review and comment cycle for the TAC and two review and comment cycles for the City are included.
- The final report will require 50 hours of senior and junior technical effort; GIS technician; graphics and administration staff. Four hours of a principal technical reviewer for QA/QC is included. Electronic distribution and fifteen hard copies.

Task 1.4 Grant Administration and Documentation

As part of best management practices and to meet requirements of the grant, all study activities will be fully, consistently, and accurately documented. This will be particularly important given the several independent future processes that will rely in some part on the documentation and findings of this study. All meeting notes, correspondence, briefings, analyses, and other documentation will be maintained by the Project Team and will be available for inspection by DWR.

Deliverables:

- Documentation and maintenance of paper and electronic project files.

Cost Assumptions

- Grant administration and documentation efforts of 4 hours per month.

Task 1.5 Public Outreach

As part of the project activities, all results will be regularly communicated to the public through available forums, City-published newsletters and website, Folsom City Council meetings, Folsom Water Community Group, SGA, SCGA and RWA. The Project Team will provide technical assistance to the City in preparation of two multi-media presentations.

Deliverables:

- Two multi-media presentations for public meetings, preparation of two City newsletter submittals, website information development.

Cost Assumptions

- Includes 40 hours of principal, senior and junior technical staff to assist the City in public outreach newsletters, website, and public forums. This estimate assumes 18 hours of effort for preparation, attendance and documentation for each presentation and that presentations will be held within the Sacramento metropolitan area.
- \$500 for presentation supplies

Task 2. Data Evaluation and Conceptual Model Development Update

As part of the 2006 Phase 1 study, a thorough review and cataloging of pertinent background information was essential to completing the proposed study in a cost-effective manner. A variety of sources were consulted, including those administered and held by state and federal agencies, local agencies, Folsom, and local utilities. A brief review and evaluation of these resources will be necessary to include the most up-to-date available information.

Task 2.1 Review of Compiled Available Water Resources Data

A thorough understanding of the local hydrogeology is essential to the development and assessment of the area's groundwater potential. To further determine whether the City's shallow aquifer system can be properly developed for potable or non-potable supply a review of any new or revised data must be conducted. Since the time of the 2006 Phase 1 study, significant repair work has been conducted on the Mormon Island Auxiliary Dam (MIAD) which is located upstream of the Study Area, that will lend valuable hydrogeologic information to the existing conceptual site model of the Study Area. A partial listing of background information that will be reviewed as part of the Study is provided here.

- U.S. Bureau of Reclamation/Army Corps of Engineers publications on recent Mormon Island Auxiliary Dam repair.
- DWR Publications regarding groundwater quality, elevations, and yields.
- U.S. Geological Survey Water Resources Bulletins or other relevant publications.
- Other relevant groundwater resources publications and reports.

Deliverables:

- Summary of review and documentation of references in QSR and draft and final reports.

Cost Assumptions

- Effort includes 20 hours of senior and junior technical staff to contact and obtain materials from state and federal agencies; review and summarize.

Task 2.2 Update Hydrogeologic Conceptual Model

The site conceptual model will be updated and prepared as a pictorial representation of the geology and groundwater flow system. Available geologic and hydrogeologic information will be updated and will continue to provide a framework for the entire project and a communication tool for the City, DWR, and other stakeholders. The conceptual model will include:

- Local and regional plan view maps showing areal geology, surface water bodies and divides
- Hydrogeologic cross sections showing important subsurface geologic features, direction and rate of groundwater flow
- Water table and potentiometric surface maps for the aquifer
- Spatial and temporal distribution of evapotranspiration, groundwater recharge, surface water-groundwater interaction, groundwater pumping, and natural groundwater discharge.

Deliverables:

- The HCM will be included in draft and final reports.

Cost Assumptions

- Effort includes 44 hours of principal, senior, and junior technical staff and GIS technician.

Task 2.3 Water Quality

Current and future water quality regulations can have a significant impact on the cost of developing and delivering groundwater to municipal and industrial customers. As groundwater can be extremely variable, it is important to acquire and update knowledge of the shallow aquifer water qualities developed for supply. Water quality data from the 2006 Phase 1 Study will be compared to the current water quality data collected to determine if any changes or trends have occurred that may impact subsequent phases of the groundwater resource study.

Deliverables:

- Summary of data and graphics included in draft and final study reports.

Cost Assumptions

- Effort includes 16 hours of senior technical staff.

Task 2.4 Land Use/Ownership

Land use and ownership maps (GIS supported) will be reviewed for all potential Phase 2 test sites. This information will be used in identifying public right-of-ways or other parcels that may be owned by Folsom or other public entities.

Deliverables:

- Summary of review in appropriate QSR and draft and final reports.

Cost Assumptions

- Effort includes 16 hours of senior, junior and GIS staff.

Task 2.5 Perform Geophysical Surveys

Used in the 2006 Phase 1 Study, electrical resistivity surveys were very cost effective and successful in siting favorable drilling targets. Electrical resistivity surveys will be used prior to drilling to determine approximate depth to bedrock in order to locate the thickest alluvial (water-bearing) zones possible. Three potential transects have been identified, and it is assumed that each transect will take one day to complete. If transects are identified to be located on private property and will not be accessible if the City cannot negotiate access authorization with the landowners, then those transects will not be completed. This task therefore assumes that the project team will prioritize the transects and that a 3-man geophysical crew will spend two days in the field and complete as many transects as possible in that period.

Deliverables:

- The draft cross sectional profiles showing the electrical resistivity results will be available for Task 2.7 and presented to the TAC with recommended drill targets.

Cost Assumptions

- Effort includes 36 hours of senior and junior technical staff and GIS technician. Staff will be onsite for field work.
- The geophysical survey contractor will cost \$12,000.
- \$300 mileage.

Task 2.6 Conduct Environmental Check

Environmental Data Resources (EDR) Radius Checks will be obtained for strategic locations to identify reported hazardous material leaks and spills that could jeopardize groundwater production

reliability. EDR Radius Checks search environmental databases such as the National Priority (Superfund) List, the United States DOT Hazardous Materials Information Reporting System, the California Department of Toxic Substance Control and similar others to locate past spill/leak history and current threats in specific areas. The resulting leak and spill sites will be posted on a map and use the data to screen potential test well sites for inclusion in Task 2.5.

Deliverables:

- Environmental documentation summary will be included in QSR; full documentation as an appendix in draft and final reports.

Cost Assumptions

- 10 hours will be required to order and review the documentation.
- Cost of environmental documentation is estimated at \$1,000.

Task 2.7 Prepare Technical Memorandum with Drill Site Recommendations

Using the information compiled in Tasks 2.1 through 2.6, the project team will recommend the boundaries of one or more areas and specific locations in which a test well and, eventually, a potential production well could be constructed. The project team will coordinate with the State of California, Department of Health Services (DHS) and the County of Sacramento, Environmental Management Department (CSEMD), and will seek their approval for potential drilling locations. The recommended drilling location(s) will be presented at a project administration meeting for approval by the TAC.

Deliverables:

- Technical memorandum preparation and distribution at administration meeting.

Cost Assumptions

- Effort includes 30 hours of senior and junior technical staff and GIS technician.

Task 3. Conduct Test Well Drilling, Construction, Sampling and Testing

These tasks include all work associated with the drilling of exploratory test borings, construction and development of a test well, aquifer testing of the test well and an initial round of water quality sampling of the test well and the existing East Natoma well. One drill site is anticipated, subject to the results of Task 2.0 above. The actual drilling depths and well construction details are also subject to the results of Task 2, subcontractor bids, and encountered field conditions.

Task 3.1 Permitting, Access Agreements, and CEQA Documentation

City-owned property, streets or right-of-ways will be given the highest priority for drilling and well locations. These locales will need access and authorization from the City. Lowest priority for wells sites are those sites located outside City-owned property that will require property ownership identification and access agreements negotiated between the City and property owner. Wells located in City streets or right-of-ways will require close coordination with the City and traffic control. Field work and safety plans will be prepared to guide all fieldwork to ensure public and worker safety.

The test well will be constructed in accordance with applicable sections of California Department of Water Resources Bulletin 74-81 "Water Well Standards, State of California" and its supplement Bulletin 74-90, and in accordance with applicable CSEMD well standards.

Environmental documentation to satisfy the California Environmental Quality Act (CEQA) requirements is anticipated to consist of a Negative Declaration.

The State of California Regional Water Control Board (RWQCB) requires a discharge permit before groundwater is pumped and discharged to streams or rivers or other surface waters. If necessary to

discharge water to Humbug or Willow Creek, a general discharge permit (Order No. R5-2008-0081, NPDES No. CAG995001) will be obtained prior to any discharge.

Deliverables:

- One set of CEQA documentation
- Two sets of Sacramento County permit applications to install test well

Cost Assumptions

- CEQA exemption documents will require 40 hours of staff time to prepare and review
- Drill permits will require 8 hours of staff time to prepare and review
- Sacramento County permit fees estimated at \$800
- Staff effort of 8 hours for City access coordination and traffic
- Assume RWQCB general discharge permit required; staff effort of 32 hours
- RWQCB permit fees estimated at \$2,500

Task 3.2 Prepare Drilling Work Plan and Contract Drilling Subcontractor

The project will require the preparation of a detailed “Drilling Work Plan” and the retention of a California licensed drilling subcontractor. The Drilling Work Plan will include Special Conditions and Technical Specifications. Special Conditions will be developed to address site-specific conditions such as:

- Construction water availability
- Utilities
- Site security
- Noise suppression, if necessary
- Fluids/solids waste disposal
- Site restoration
- Other site-specific subcontractor requirements

Technical Specifications will be developed to establish work descriptions, acceptable materials, test and well construction execution protocol, record keeping, submittal requirements and other project components. The Technical Specifications will also address the following critical issues:

- Drilling methods
- Formation sampling/methodology
- Borehole sizing requirements
- Casing dimensions and composition
- Gravel pack material
- Surface sanitary seal material makeup and installation procedures
- Well development protocol
- Short and long-term pumping and sampling actions
- Other project design and procedural elements

“Drilling Work Plan” activities will be conducted under the direct supervision of a California Professional Geologist, a Certified Hydrogeologist or a Professional Engineer and will include, but not be limited to, oversight of all drilling, casing installation, gravel pack and seal placement, well development, pump testing and water quality sampling activities.

Deliverables:

- Drilling Work Plan electronic deliverable to City for review. Attached to QSR.

Cost Assumptions

- Effort includes 32 hours of senior and junior technical staff and GIS technician.

Task 3.3 Well Installation and Development

Based upon information gathered during the previous investigations it is anticipated that one 6-inch diameter well will be installed in the vicinity shown on Figure A5-1. Following procurement of the access authorization and drilling permit the site will be marked in white paint and underground service alert notified to clear underground utilities. A private utility locator will be used to locate other underground utilities and clear the drilling area. It is anticipated that the well depth and drilling methodology will be similar to the Phase 1 investigation.

The borehole will be advanced using air rotary casing hammer drilling methodology to allow for accurate collection of lithologic and production rate data. The drilling will be completed during business hours between 7 am and 6 pm due to the proximity to residential areas. The drilling locations are anticipated to be within City right-of-ways along bike paths and city streets. Drill cuttings are planned on being spread on land surface adjacent to the drill site and water produced during drilling will be discharged to land surface or storm water retention basins in the vicinity of the drill sites. The State of California Regional Water Control Board requires a discharge permit before groundwater is pumped and discharged to streams or rivers or other surface waters. If necessary to discharge water to Humbug or Willow Creek, a general discharge permit (Order No. R5-2008-0081, NPDES No. CAG995001) will be obtained prior to any discharge.

A six-inch diameter test well will be constructed inside the borehole using schedule steel well casings, with an assumed 0.050 inch slotted steel screen, a generalized well design is illustrated in Figure A5-2. The depth of the wells and the length, depth and slot size of the screen will be determined in the field based on the lithology, the depth to static water, the depth to bedrock, and drilling conditions. The existing water table will be identified during drilling by a change in the moisture content of the cuttings and be compared to water level measurements in the East Natoma well. The test well is expected to be completed to about 130 feet bgs and screen intervals will be determined based on drilling observations and water levels from nearby wells. The assumed annulus will consist of a filter pack of No. 8 mesh sand, with an intermediate 3 foot seal of bentonite pellets, and then sealed to the surface with neat cement. The well design will be determined based upon field observations and will be consistent with Chapter 6.28 of the Sacramento County Code and Section 13801 of the California Water Code. The wells will be completed above ground with metal standpipes and locking caps.

Following completion of the well, the grout seal will be allowed to set for at least 24 hours prior to initiation of well development. The well will be developed by surging, bailing, or pumping until clean, sediment-free water is produced. The length of development time will vary, depending on field conditions, but approximately 4-8 hours is assumed. During development, field parameters will be evaluated to document development, these field parameters will include: turbidity, pH, temperature, specific conductivity, and oxidation-reduction potential and will be recorded on field records. The well will be developed until it is free of suspended sediment and turbidity values are less than 10 NTU.

No sooner than 48 hours after development, the well will be sampled for general water quality, major cations and anions, and general minerals and volatile organic compounds using EPA Method 8260. The water quality analyte list is provided in Table 1 below. Before a sample is collected, water levels will be collected using an electric well sounder to the nearest 0.01-foot. The wells will then be purged until a minimum of three well casing volumes have been removed and water characteristics such as temperature, pH, and electrical conductivity have stabilized. All wells will be sampled immediately after purging. If the well is purged dry, the well will be allowed to recover to approximately 80 percent of the static water level prior to sampling. All water quality samples will be submitted to a California Licensed laboratory under proper chain of custody procedures.

CITY OF FOLSOM SUPPLEMENTAL GROUNDWATER RESOURCES STUDY
CITY OF FOLSOM LOCAL GROUNDWATER ASSISTANCE GRANT APPLICATION 2012

Table 1. Analytical Parameters, Sampling and Preservation Methods

Parameter	EPA Method	Container	Preservation	Analysis Hold Time ^a
Volatile Organic Compounds	EPA8260	40 ml glass VOA	HCl	14 days
Anions (nitrate, chloride, carbonate, bicarbonate.)	EPA 300.0	250 ml polyethylene	Field Filter Ice to 4° C (Cl: none)	28 days
Nitrate as Nitrogen	EPA 300.0	250 ml polyethylene	Field Filter, H ₂ SO ₄ to pH<2; Ice to 4° C	48 hrs
Alkalinity	EPA 310	250 ml polyethylene	Field Filter, none	14 days
Metals (arsenic, iron, manganese) and Cations (sodium, potassium, calcium, magnesium)	EPA 6010B	500 ml polyethylene	Field Filter, HNO ₃ to pH<2; Ice to 4° C	6 months
Total Dissolved Solids	EPA 160.1	250 ml polyethylene	Field Filter, none	7 days
PH, temperature, oxidation-reduction potential, specific conductivity, dissolved oxygen, and turbidity	Field instrument	250 ml polyethylene	none	Field

^a Starting from the date of extraction; if no extraction is involved, starting from the date of collection
Abbreviations: ml = milliliter oz = ounce

The Phase 2 study will include contracting a Professional Land Surveyor (PLS) to survey the new test well. In order to compare data from the existing test wells, the well will be referenced to the City's elevation datum and NAD83 coordinates and surveyed for vertical and horizontal location. A map will be provided by the PLS with locations of landmarks, ground surface elevations and top of casing elevations and will be included in the final study report.

Deliverables:

- Data collected during this task will be included in the draft and final report described in Task 1.3.

Cost Assumptions

- Drilling and logging of samples will require 3 days of staff time per well to provide oversight to drilling operations.
- Oversight will be performed for 10 hours per day of drilling.
- Test well will cost \$33,000 to drill, install, and develop.
- Laboratory fees of \$1,800.
- Clearance of underground utilities will cost \$700
- Surveyor fee of \$3,300
- \$300 mileage
- \$500 equipment rental

Task 3.4 Surface Water Monitoring

To account for any surface water/groundwater interaction prior to and during aquifer testing, the depths of two nearby ponds will be measured and the surface elevations monitored. A cross-sectional pond profile survey will be conducted to determine the cross-sectional area and depth of the ponds. The surface elevation and total depths of the ponds will be compared to the depth of

water encountered during drilling and static water levels in the East Natoma well and the newly-installed test well.

Temporary pond gauges with stilling wells and pressure transducers will be installed for continual monitoring of pond stage. It is estimated that a maximum of two gauges will be required and the gauge posts will be hand driven into the pond.

Stilling well pressure transducer readings will be collected for at least one week prior to aquifer testing for baseline purposes, during the aquifer tests and for one week after the recovery portion of the aquifer tests. Rates of pond elevation changes will be evaluated for the entire period of collection.

Deliverables:

- Data collected during this task will be included in the draft and final report described in Task 1.3.

Cost Assumptions

- Staff time required to conduct field work is 32 hours.
- Purchase/rental of two pressure transducers is \$3,300.
- Staff gauges and stilling wells costs is \$1,000.
- Mileage of \$300

Task 3.5 Perform Aquifer Testing and Analysis

One 72-hour aquifer test is planned for the newly installed test well. During the aquifer test, the other well will act as an observation well and equipped with a pressure transducer. Prior to using the the East Natoma well for observation, the well will require pre-development to remove any debris or fines that may have accumulated in the over time.

The 72-hour aquifer test will be conducted following the completion of development and sampling of the groundwater as described in the previous section. Aquifer testing will be performed utilizing a submersible pump with an anticipated capacity of 400 gpm, based upon previous production rates from wells completed during Phase 1. The test will consist of a step-test to determine appropriate flow rate, a constant discharge test for 72-hours of continuous pumping, and a recovery test. Aquifer tests will be conducted to assess the yield and aquifer parameters of transmissivity and storage estimates.

Given the geologic formation and relative shallow nature of the groundwater, in order to determine the sustainable rate the discharge water and eliminate short circuiting/recharge effects water will be temporarily piped and discharged downstream. This 4-inch diameter PVC pipeline will be installed from the pump to at least several hundred feet downstream from the pump location where it will be discharged to land surface, storm water basins and/or Willow or Humbug Creek.

For all of the testing procedures listed below water level data will be collected using submersible pressure transducers and data loggers, in particular In-Situ® Level Trolls 500 or 700 series. These transducers are capable of measuring water levels to within 0.01 feet and temperature to 0.01 °C. The logging capabilities and data storage allow for a variety of programmable solutions necessary to observe subtleties necessary to accurately evaluate aquifer properties. Hand measurements will be made throughout the test to confirm transducer readings.

Following the completion of the constant rate test a water sample will be collected and analyzed for general physical parameters of pH, temperature, electrical conductivity (EC), oxidation-reduction potential (ORP), and dissolved oxygen (DO).

The following components will be performed to characterize the aquifer being tested. The components include: background monitoring, step-drawdown testing (step test), constant rate testing (constant test), and recovery testing. The components are described below.

Background Monitoring

Background monitoring will be conducted for a period of 1-week prior to the start of the Step test. The background water level data will be assessed to determine if any outside stresses (ie domestic or agricultural pumps) are operating and need to be monitored during the testing.

Step-drawdown Test

A step-drawdown test will be performed on the East Natoma well and the new well. Step-drawdown testing will be run for approximately two hours for each increasing extraction rate to allowing for stabilization of drawdown, four steps will be performed for a total of an 8-hour test. The extraction rates will be run at approximately $\frac{1}{2}$, $\frac{3}{4}$, 1, and $1\frac{1}{2}$ times the design capacity for the well. The discharge rate will be assessed using an in-line flow meter with flow totalizer.

The drawdown of the extraction well will be monitored with a pressure transducer and hand measurements for confirmation purposes. The logging interval will be set to a logarithmic time scale and reset for each step to assure early-time data is collected to develop appropriate drawdown curves.

Water quality physical parameters of pH, temperature, EC, ORP, and DO will be monitored throughout the test. Following the shut down of the pump at the conclusion of the step-drawdown test, the aquifer will be allowed to recover for approximately 1 day.

The drawdown data will be used to determine the specific capacity and well efficiency of the well and determine a flow rate to be used during the constant rate test.

Constant Rate Test

Following the complete recovery of the step test, the constant rate test will be run for 72-hours. The pumping will be managed to maintain a constant discharge rate and assessed using an in-line flow meter with flow totalizer. Flow rate will be evaluated throughout the 72-hour duration of the test. It is assumed that water will be discharged to land surface or to a surface impoundment at some distance from the well such that it will not impact the test performance, as described above.

The drawdown of the extraction well will be monitored with a pressure transducer and hand measurements for confirmation purposes. In addition to the extraction well, available monitoring wells, within the estimated area of influence, will be outfitted with pressure transducers. Transducers will be installed in monitoring wells screened within the aquifer being pumped. The logging interval in all wells will be set to a logarithmic time scale for the constant rate test.

The pH, temperature, EC, ORP, and DO in the discharged water will be monitored daily throughout the test. Following the shut down of the pump, the transducers will be reset to monitor water levels on a logarithmic scale during the recovery period.

The drawdown and recovery data from the pumping well and observation wells will be used to determine the aquifer properties of transmissivity, hydraulic conductivity, and storativity in the pumped aquifer.

Results from aquifer tests will be analyzed using a variety of methods. Pumping tests will be evaluated using standard type curve fits for time-drawdown data (Theis, Cooper-Jacob, Cooper et al., Hantush-Jacob), with the exact method dependant on observed leakage. Type curve fits will be done manually in the field, but final results will be determined by a computer best-fit and calculation using Aqtesolve or a similar program. These methods use the same basic data sets, but provide different solutions for transmissivity and hydraulic conductivity..

Deliverables:

- Data collected during this task will be included in the draft and final report described in Task 1.3.

Cost Assumptions

- Field work will require 200 hours of principal, senior and junior staff time to prepare for and perform the aquifer testing.
- Pump test subcontractor fees of \$29,000
- Mileage \$700
- Equipment rental \$3,300

Task 4. Monitoring Data and Reporting

This task includes obtaining and compiling water level and water quality data for the existing East Natoma and Glenn Drive wells and the new test well. Water levels will be collected for a total of two monitoring events and groundwater sampling will occur on the second monitoring event.

Groundwater samples will be collected from all the three wells listed above and analyzed for water quality characterization. All work will be performed according to SGA's GMP SOPs and other standard industry practices, which will be documented in a Field Sampling Plan prior to initiation of work. These constituents may include general minerals and selected metals. Field measurements, when acquired, will be entered into SGA's database.

Water quality samples will be analyzed for general minerals, pH, and total dissolved solids. Cations and anions will be graphically represented using either Piper plots or Stiff diagrams. These diagrams are used to assess the general water chemistry of the samples for comparison with previous sampling and other water samples in an attempt to assess spatial variations.

Before a sample is collected, water levels will be collected using an electric well sounder to the nearest 0.01-foot. The well will then be purged until a minimum of three well casing volumes have been removed and field parameters (temperature, pH, and electrical conductivity) have stabilized or the well is pumped or bailed dry. All wells will be sampled immediately after purging. If the well is purged dry, the well will be allowed to recover to approximately 80 percent of the static water level prior to sampling.

The groundwater samples will be collected with a new disposable bailer attached to a new or decontaminated line. After groundwater has been collected inside the bailer, the groundwater will be transferred to laboratory certified containers. The samples will be labeled and refrigerated with ice, then transported under chain-of-custody to a state-certified analytical laboratory. Each sample will be submitted for analysis of the following analytes:

- Total dissolved solids (TDS) by EPA Method 160.1;
- Nitrate (NO_3) as nitrogen by EPA Method 300;
- General minerals by various methods to include: calcium, magnesium, potassium, sodium (cations), chloride, fluoride, sulfate, phosphate, and total alkalinity (anions); and
- pH.

Sample preservation will be performed immediately upon sample collection except when specifically allowed by the selected method. The contract laboratory will be responsible for inspecting preservation documentation at the time of sample receipt to assure samples are properly preserved.

Updates on the monitoring results will be provided as described in the regular Quarterly reports described under Task 1.0. After completion of the two monitoring events that are included in this Work Plan, the City of Folsom intends to continue semi-annual monitoring as per the SGA GMP.

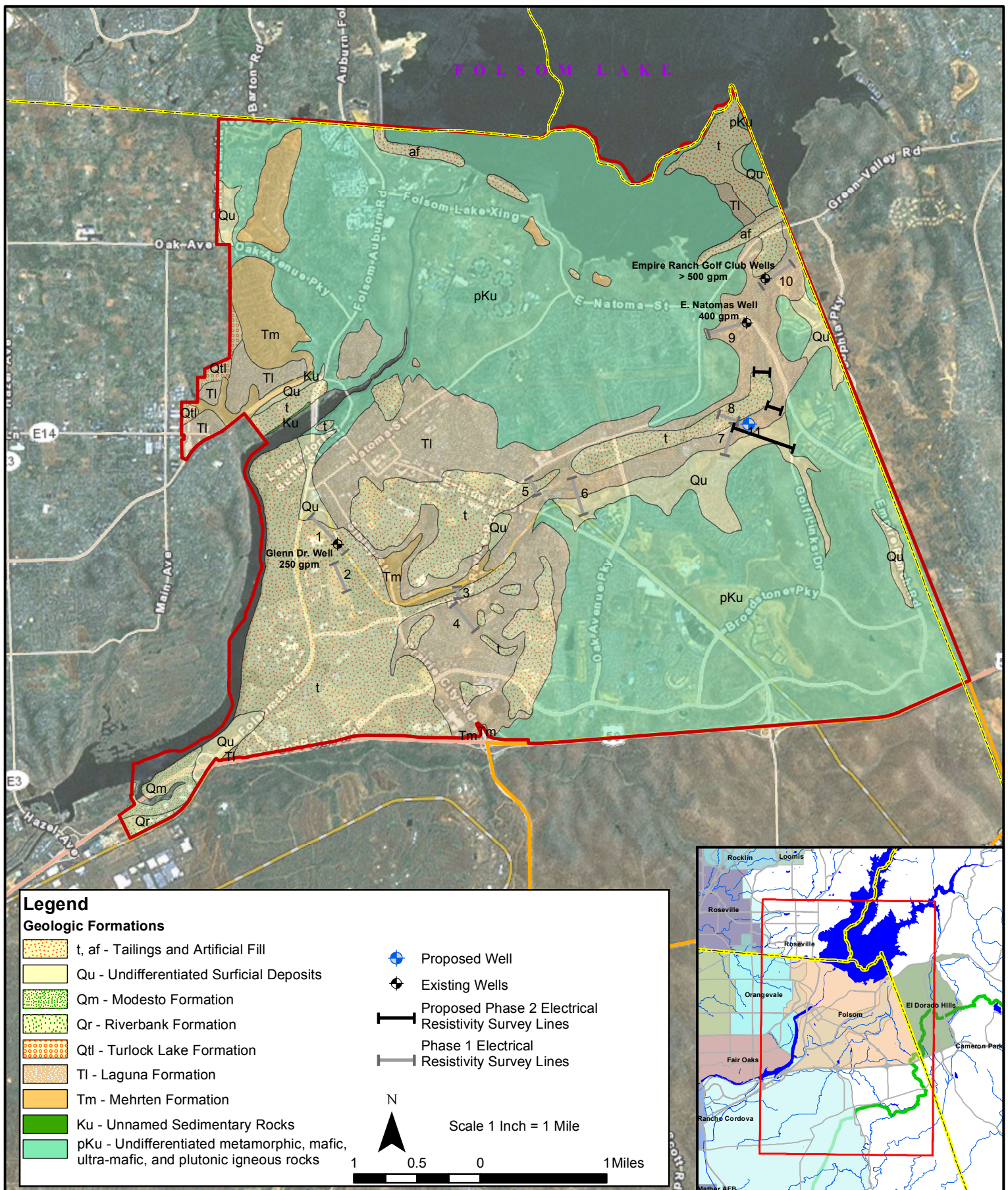
It is assumed that the data from this project will then be entered into an existing GIS database (such as SGA's DMS) using industry standard QA procedures.


Deliverables:

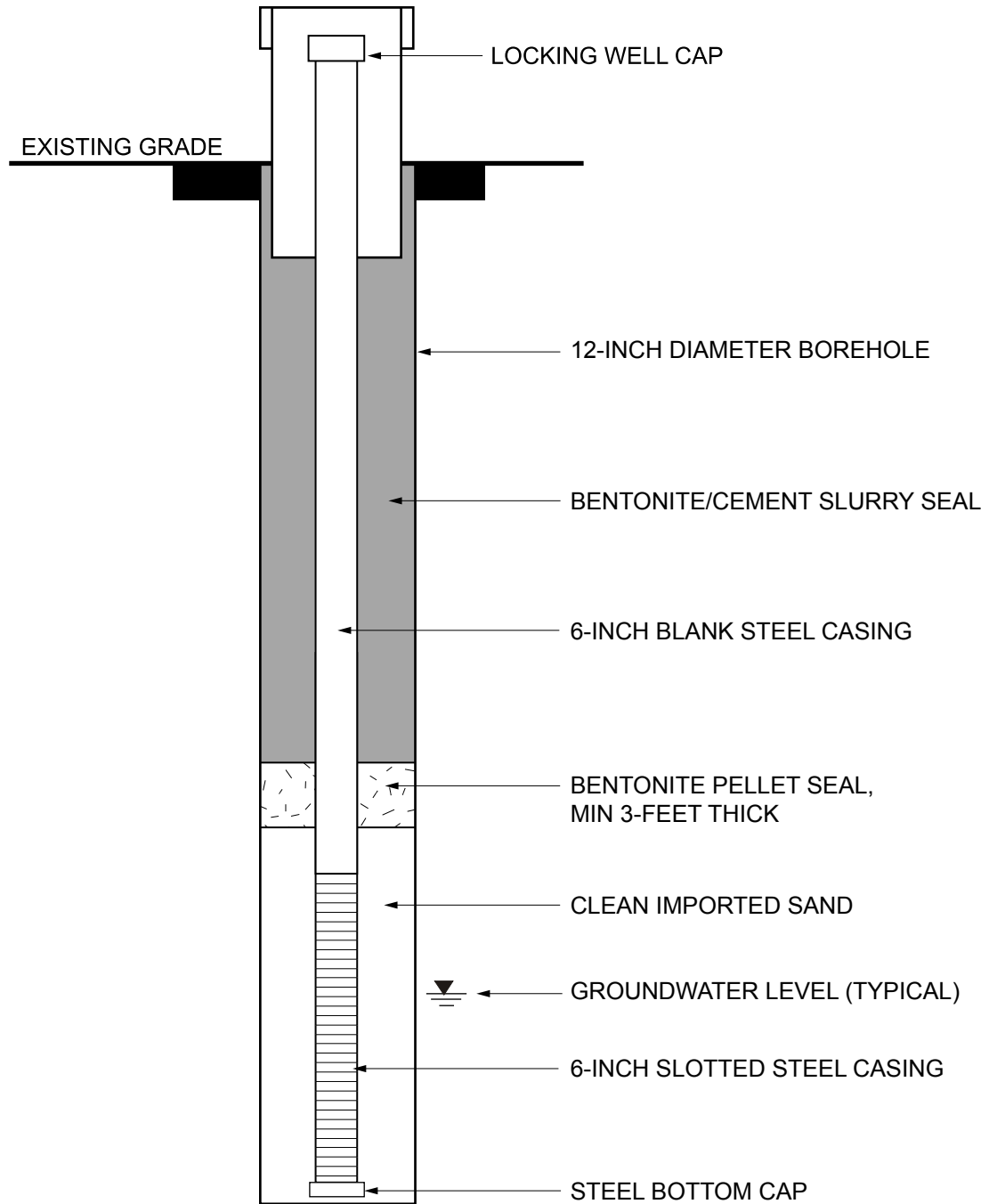
- Data collected during this task will be included in the draft and final report described in Task 1.3.

Cost Assumptions


- Field work and reporting will require 85 days of principal, senior and junior staff time.
- Laboratory fees of \$1,000
- Mileage \$200
- Equipment and supplies \$250



 CITY OF FOLSOM DISTINCTIVE BY NATURE	PROJECT 131097-012	SITE City of Folsom Groundwater Resources Study Phase 2	Figure A5-1
	DATE 7/9/2012	TITLE Location and Geologic Map	



SECTION
NOT TO SCALE

DATE 7-9-12	PROJECT 131097-012	SITE City of Folsom Groundwater Resources Study, Phase 2, Folsom, California	Figure A5-2
		TITLE Well Construction Diagram	